LUATION OF STRENGTH
OF THE REACTION-SINTERED MATERIALS BASED ON SIC AND B_4C

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Reaction sintering of materials based on SiC (RBSiC) and B_4C (RBBC) is one of the promising approaches for creating advanced materials, operating under high static and dynamic loadings. RBBC, due to its low density, is an interesting alternative to traditional armor materials.

At stage of materials designing the adequate assessment of the reproducibility of its physical and mechanical properties is very important. In present work we used Weibull distribution for the statistical evaluation of the strength of reaction-sintered ceramics. This theory allows us to quantify the structural heterogeneity of the material: a random distribution of the pores in volume of the sample, the presence of microcracks and local concentration fluctuations.

RBSiC samples were prepared by technology of OAO "CNIIM" by reactive infiltration of porous green body (SiC+C) with the liquid silicon. RBBC experimental samples were prepared by similar technology but with containing of 60 % vol. boron carbide. Sintered at 1650° C and polished samples were tested on three-points flexural strength by testing electro-mechanical machine with static regime of loading (±1%). Average values of flexural strength σ_f were 340 and 300 MPa for RBSiC and RBBC respectivly.

The probability distribution of critical stresses quite correctly described by the two-parameter equation:

$$P(\sigma_f) = 1 - \exp\left[-\left(\frac{\sigma_f}{\sigma_0}\right)^m\right], (1)$$

where m is homogeneity index (Weibull modulus); σ_0 - normalizing parameter.

As it was found by the least-squares method, for RBSiC m = 13.6 and 9.6 for RBBC, which indicates a greater heterogeneity of the structure of the RBBC.

Analysis of structure indicated that the heterogeneity associated with local deviations of components concentration in the porous green body (especially distribution of free carbon), which resulted in formation of various micro-volumes in sample, where mainly took place one of the two competing reactions:

$$Si_{(s)}+C_{(liq)} \rightarrow SiC_{(s)}, \quad (A)$$
$$B_4C_{(s)}+Si_{(liq)} \rightarrow SiC_{(s)}+B_{12}(B,C,Si)_3, \quad (B).$$

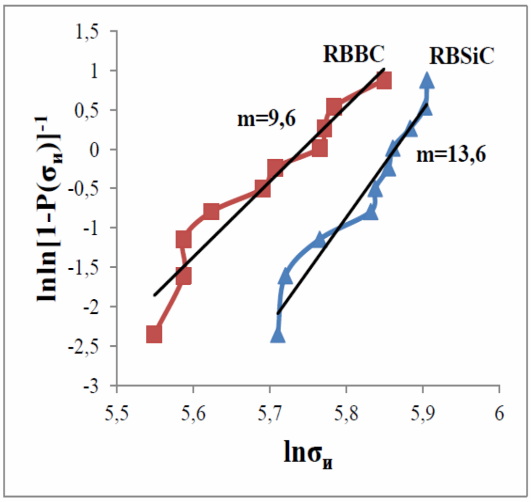

Рис. 1 Distribution of σ_f values for RBBC and RBSiC

Formed by the reactions (A) and (B) phases due to differences in their morphology, particle size and physical and mechanical characteristics decrease homogeneity of structure.

Possibly, use as a carbon source only B_4C (reaction B) without a free carbon in green body makes it possible to avoid deviations of concentration and competitive synthesis of new phases.

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